

Delaware & Raritan Canal: Lock 6A
Between Greenwood and Hamilton Avenues
Trenton
Mercer County
New Jersey

HAER No. NJ-62

HAER
NJ
11-TRET,
38-

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA
MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD
MID-ATLANTIC REGION, NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HISTORIC AMERICAN ENGINEERING RECORD

DELAWARE AND RARITAN CANAL:
LOCK 6A

HAER NO. NJ-62

HAER
NJ
11-11-88
38-

LOCATION: Between Greenwood and Hamilton Avenues,
Trenton, Mercer County, New Jersey
UTM: 18.520640.4451430
Quad: Trenton, West PA-NJ

DATE OF CONSTRUCTION: 1929-30

PRESENT OWNER: City of Trenton, New Jersey

PRESENT USE: Abandoned 1933, filled in 1936

SIGNIFICANCE: Lock 6A is a representative example of canal lock design and construction of its time. It was the last lock to be constructed on the Delaware and Raritan Canal, which was first placed in operation in 1834. The impetus for construction of Lock 6A was the electrification of the Pennsylvania Railroad's main line, over which a portion of the canal was carried by means of an aqueduct. In order to provide sufficient clearance for the electrical wiring, the existing aqueduct was raised; Lock 6A was therefore built to accommodate the difference between the level of the raised aqueduct and that of the canal downstream.

PROJECT INFORMATION: Lock 6A was recorded July 1988 by the Cultural Resource Group of Louis Berger & Associates, Inc., East Orange, New Jersey, for the New Jersey Department of Transportation, Trenton, and the Federal Highway Administration. The work was carried out in conformance with a Memorandum of Agreement between the Federal Highway Administration, the New Jersey State Historic Preservation Office and the Advisory Council on Historic Preservation. The project team consisted of John A. Hotopp, Ph.D., Director; Edward M. Morin, Archaeologist; Martha H. Bowers, Architectural Historian; Anthony Masso, Photographer; Ingrid Wuebber, Research Historian; and John R. Bowie AIA, Consulting Architect.

DESCRIPTION:

Lock 6A of the Delaware and Raritan Canal is located between Hamilton and Greenwood Avenues in the southeast portion of Trenton. The former Pennsylvania Railroad main line (now CONRAIL) lies directly north of the lock, and a branch line parallels the lock to the east. Lock 6A was partially filled in, in 1936, and has been further filled with trash in the decades since that time. The immediate neighborhood still possesses vestiges of its industrial past.

Lock 6A is 213 feet long between gates, 24 feet wide, and at the gates about 16-1/2 feet deep. The lock is constructed of poured concrete in which the horizontal pattern of the wooden formwork remains evident. The lock walls between the gates are approximately 4 feet thick.

The lock was fitted with two pairs of heavy timber mitre gates which, when closed, butted against a timber sill on the lock floor. The sills were mortised against the concrete, and secured by iron bolts. The gates were assembled with mortise and tenon joining, and from the width of the bottom rail were approximately 1-1/2 feet thick. At each end of the sills against which the closed gates rested was an upright semicircular channel formed into the concrete of the lock walls. Within these channels the heel posts of the gates turned. Each post was seated on an iron pivot let into the floor of the lock, and secured to the frame of the gate by metal cuffs. When open, the gates swung back into recesses approximately 16 feet long and 2 feet deep, and thus flush with the walls of the lock. Timber bumpers projected from horizontal niches in the walls of the recess; the presence of these bumpers prevented damage to the wooden gates when the latter were opened to their fullest extent. Along the base of each gate was a row of cast-iron wickets, mounted in frames bolted to the upstream side of the gate. Each of these wickets, about 2 feet square, was mounted on a vertical axis about which it could be turned. These wickets were the means by which the water level in the lock was controlled. According to the 1930 Appendix Report on Proposed Abandonment, the lift provided by Lock 6A was 2.5 feet (Pennsylvania Railroad 1930).

Beyond the upstream (north) end of the lock proper (between the upstream gate and downstream abutment of the aqueduct over the railroad line) is a polygonal forebay by which excess water was diverted when the upstream lock gates were closed, thus controlling the level of water in the canal upstream from the lock. The forebay channeled water over a low concrete regulating weir into a well of approximately 3 x 11 foot dimension. Three overflow intakes, each 2'5" diameter, are positioned in the wall of the well opposite the weir to convey water along the east side

of the lock and back into the canal below the lock. The diversion of water from the forebay could also be increased by means of a small gate (no longer present) on the east side of the intake well.

Boats within the lock were secured by means of ropes turned around snubbing posts set outside the lock walls at irregular intervals. Six of these posts remain along the west side of the lock, between the gates, and five on the east side. Each post is set on a concrete plinth and secured into the ground by a steel pile.

The CONRAIL line of four tracks, running at approximately a 45-degree angle from the axis of the lock, is located about 80 feet beyond the upstream lock gates. The aqueduct that carried the canal over the tracks was removed when the canal was filled in in 1936. The original abutments for the aqueduct are constructed of coursed quarryfaced traprock. Both abutments show evidence of the reconstruction which in 1929-30 increased the clearance of the aqueduct over the tracks by about three feet. The walls of the canal at either end of the aqueduct were also reconstructed with concrete. Horizontal timber planking, secured to the walls against vertical nailers bolted to the walls, protected boats from damage while negotiating their way into and out of the aqueduct.

Stripped of operating equipment and appurtenant structures, Lock 6A displays basic characteristics of lock technology appropriate to the time and circumstances in which it was built. The lock's 24-foot width was standard for the Delaware and Raritan Canal since the 1850's, and its 213-foot length was not significantly greater than the 210 feet common at other locks on the canal. Lock 6A's concrete construction was a function of its time, as by 1930 concrete was far more cost- and time-efficient a material to use than the quarried stone from which the original locks were built a century before. The presence at Lock 6A of two sets of mitre gates, rather than a drop-type upstream gate, also reflects the passage of time on the canal: one of the chief virtues of drop gates is that they could be operated by one man from one location, mechanically or by steam power. The efficiency thus achieved would have been important during the 19th century heyday of the canal. By 1930 however, the canal's days were clearly numbered, and the Pennsylvania Railroad unlikely to spend more than absolutely necessary on construction of a lock on a canal with increasingly declining amounts of traffic. Although two locks, 7 and 14, were electrically operated in 1930 no evidence has been located to indicate that Lock 6A was operated in that manner (McKelvey, Personal Communication, 1989). Thus it is reasonably assumed that Lock 6A's two sets of mitre gates were manually operated in the two shipping seasons prior to abandonment of the entire canal.

HISTORICAL INFORMATION

[Note: This section is largely excerpted from The Delaware and Raritan Canal, 28Me108, Site Analysis, Assessment of Condition and Proposed Mitigation Plan, a report prepared by Louis Berger & Associates, Inc. for the Federal Highway Administration and New Jersey Department of Transportation, dated June 1983.]

The idea of building a canal across New Jersey to link the Delaware and Raritan Rivers is said to have originated during the Colonial period but it was not until 1796, when the Assunpink Creek Navigation Company was incorporated, that any action was taken towards realizing this notion (Madeira 1941:7). However, the Assunpink Creek Navigation Company apparently never carried out their plans for improving existing streams for navigation and linking them with canals. In 1816, a commission was set up to determine the most suitable route and to estimate the cost of construction. The route proposed at this time was virtually the same as the one eventually constructed, and the cost was estimated at \$1,000,000. In the 1820s a charter was granted to the Delaware and Raritan Canal Company by the New Jersey legislature but the company could not raise enough capital to begin construction. The charter was voided but between 1820 and 1830 further attempts were made to get the project off the ground. The route and cost were checked by Canvass White, one of the senior surveyors of the Erie Canal, who was appointed chief engineer of the Delaware and Raritan Canal in 1825. White confirmed the suitability of the alignment already proposed but revised the cost estimate upwards to almost \$2,000,000 (Cawley and Cawley 1970; McKelvey 1975; Menzies 1976; Bastoni 1982).

Even at this early stage, public enthusiasm for the canal lagged behind that for the projected Camden and Amboy Railroad. Conflict between proponents of the canal and railroad came to a head in 1830 because of this rivalry, and the state legislature granted charters to both projects on the same day February 4, 1830. The Camden and Amboy Railroad sold all shares within minutes of authorization but the Delaware and Raritan Canal Company took some months to raise the necessary backing and only then through the infusion of funds by the wealthy Stockton family of Princeton. Nevertheless, the wariness with which each project regarded the other led in 1831 to the Camden and Amboy Railroad and the Delaware and Raritan Canal Company merging to form the "Joint Companies." This marriage of convenience included a clause preventing the construction of competitive lines of transportation across central Jersey for thirty years. As a result, the Delaware and Raritan Canal was able to establish a sound and relatively unchallenged economic position which it maintained until the last quarter of the 19th century (Veit 1963; Menzies 1976).

Both canal and railroad began construction in the fall of 1830. Excavations for the canal were begun under Canvass White's supervision in both Trenton and Kingston, and the 14 mile long upper level of the canal between these two points was completed and opened to traffic in 1833. The full length of the canal was formally opened on June 25 of the following year.

When completed in 1834, the main line of the Delaware and Raritan Canal between Bordentown and New Brunswick extended 43 miles and included 14 locks. The feeder canal which tapped the Delaware River at Bulls Island and fed into the upper level of the main canal in Trenton extended 22 miles and passed through three locks. The Delaware and Raritan was essentially a contour canal, that is to say, it took the line of least resistance and followed the contours of the ground. The initial specifications called for a canal 50 feet wide by 5 feet deep; but this was soon changed to 75 feet wide by 7 feet deep. The dimensions of the feeder were also enlarged from 30 feet wide by 4 feet deep to 60 feet wide by 6 feet deep (Madeira 1941:31; Veit 1963:70).

A good description of the locks was given by Ashbel Welch in 1850, who described the canal as follows:

"This canal was built with fourteen locks--seven west of the summit overcoming an elevation of fifty-seven feet; and seven east of the summit, overcoming an elevation of fifty-eight feet. These locks are twenty-four feet wide, with a space of one hundred and ten feet between the gates, from point to point, and a total length of one hundred and sixty-five feet. The lock walls have cut faces, and are laid, like other masonry on the canal and feeder, with hydraulic cement" (quoted in McKelvey 1975:7).

A more contemporary (although less detailed) description was written in October 1833 when the canal was almost completed. In this account the difference in elevation between Trenton and Bordentown is given as 58 feet "overcome... by seven locks; one at Trenton of seven feet; one at the State Penitentiary of seven feet; three at Lamberton of nine feet; one below Lamberton of seven feet; and one at Bordentown of 10 feet lift") Gordon 1834: 27-28).

In addition to the 14 locks on the main line there were 29 pivot bridges, 17 culverts and one aqueduct. On the feeder there were 37 pivot bridges and 15 culverts. Besides these features there were other structures such as lock keepers' houses, mule barns, loghouses which enclosed the lock mechanisms, tool houses,

bridgekeepers' shanties, and canal basins (Gordon 1834:27-28; Madeira 1941:36).

The Delaware and Raritan appears to have been successful from an early date, primarily because of its value as a means of transporting coal from the anthracite coal fields of Pennsylvania to the developing industrial cities of the New York Bay area and Lower Delaware Valley. In 1846, 600 barges were in operation on the canal and by 1859 the number had increased to 1400. The existence of the "Joint Companies" undoubtedly protected the canal from competition and the increasing traffic on the waterway resulted in navigation improvements. In 1849 the canal company began to replace the upper lock gates on the main line with drop gates; in 1851 the depth of the canal was increased by dredging to eight feet; and in 1853 the length of the main line locks was increased to 220 feet and the canal banks were rip-rapped (Veit 1963:23; Cawley and Cawley 1970:34; McKelvey 1975:4-5). All these measures were designed to increase the efficiency of the canal. Drop gates were lighter and easier to operate than miter gates, and were an innovation first used by Canvass White on the Lehigh Canal in Pennsylvania which was completed in 1829 (HCRS 1981:10; Bastoni 1982:58). Dredging the canal made it possible for boats with greater draughts to use the waterway. Another major advantage was the decrease in resistance to the passage of boats when the prism of a canal was enlarged (Sweet 1880:100). The greater length of the locks allowed two boats (moving in the same direction) to be locked through at once and meant a considerable saving in time for the journey through the canal.

The greatest period of canal prosperity was between 1850 and 1875. The peak year for the canal before the Civil War was 1860 when a total of 1,639,997 tons of freight was transported through the waterway and the company paid a dividend of 12 percent. The busiest year of all time for the canal, however, was 1866 when 2,857,244 tons of freight were carried, of which 2,282,203 tons were anthracite coal (Madeira 1941:49, 51, 53-54; McKelvey 1975:5). The success of the canal continued to stimulate rapid industrial growth in both Trenton and New Brunswick but the two cities developed in noticeably different ways. Trenton industries (iron and steel, ceramics) utilized the Delaware and Raritan Canal chiefly for transportation purposes. Coal, iron, clay, feldspar, flint, and other raw material were shipped into the city by canal while metal and ceramic products were shipped out. New Brunswick industries (textiles, paper, rubber), on the other hand, in addition to using the canal for transporting raw materials and products also made use of it as a source of water power. The reasons for this are largely geographical. Lock 13 with its substantial lift of 12.2 feet lay immediately upstream from the industrial core of New Brunswick and the canal therefore could be tapped on the upstream side of the lock and used to

power industries along the Raritan River. In the Trenton area, the locks with the greatest lift, Locks 2, 3, and 4, lay on the downstream side of the city and a similar head of water could not be developed in the city for industrial hydropower purposes. Trenton, overcame this disadvantage by constructing a separate water power canal at the same time as the Delaware and Raritan Canal.

The prosperity of the canal also resulted in continuing improvements to the waterway. In 1858, for example, all the bridges except two were widened in order to allow two boats to pass through them simultaneously. The boom years inspired Ashbel Welch in 1868 to apply steam power to the 13 locks on the main line. A dozen years later, in a published paper, he wrote that the steam-powered locks had increased the efficiency of the canal by 50 percent. The application of steam power to the locks was the last of the major improvements to the canal although Locks 7 and 14 were later altered so that they could be opened and closed electrically (Welch 1880:295; Veit 1963:80; McKelvey 1975:67).

In 1867 the Joint Companies merged with the New Jersey Railroad and Transportation Company to form the "United Companies" possibly in anticipation of the problems which would ensue with the expiration of their state monopoly on regional transportation in 1868. Four years later the property of the United Companies was leased to the Pennsylvania Railroad Company for 999 years and the volume of freight carried on the canal (in particular coal) soon began to decline as the obvious advantages of rail over canal transportation were exploited. Traffic on the canal declined even more sharply after 1876 when the Reading Railroad procured its own line across the state. The Pennsylvania Railroad spurred on by the competition from the Reading increased its main line to four tracks though Princeton Junction in 1893. The canal was left struggling to survive with less and less freight. The effect of the competition from these two railroads on the canal was expressed by the rapidly falling revenues from 1882 onwards, culminating in the canal's first operating deficit in 1893 (Madeira 1941:55; Veit 1963:81; McKelvey 1975:5; Menzies 1976:109).

The final chapter in the history of the canal's operation is the story of its decline from 1893. Unable to compete with the railways, the canal never made a profit after 1900. A brief resurgence occurred during World War I, but was not sustained in the post-war years. As described in the Pennsylvania Railroad's 1930 Appendix to Report on Proposed Abandonment, "...In 1922 anthracite coal was the principal commodity [shipped on the canal], followed by bituminous coal and oil. In 1929 shipments of anthracite had fallen to about one-third of the 1922 figure and about one-fifth of the 1924 movement, which was the peak in

recent years...Bituminous has had a steady decline and in 1928 and 1929 was not handled at all. Oil, including gasoline, was in 1927 almost double the 1922 tonnage, but in 1928 fell off a third; in 1929 it was less than one-fourth of 1927...Total annual tonnage of coal and merchandise during the last eight years reached a maximum in 1924, since which time it has fallen off rapidly." In 1931 freight on the canal amounted to only 41,801 tons. In December 1932, at the end of that year's shipping season, the canal was closed permanently. The following year, the Pennsylvania Railroad and the United Companies filed Certificates of Abandonment. In 1934, taken over by the State of New Jersey the canal was placed under the jurisdiction of the State Highway Commission. That portion of the canal within Trenton was conveyed to the city, and in 1936 was filled in as part of a WPA Project (Madeira 1941:79; Trenton Evening Times, April 9, 1936, p.1).

Lock 6A was constructed during the winter of 1929-30, following the end of the 1929 shipping season on the canal. It thus was in operation only three years, and partially filled within six years after its completion. Raising the aqueduct and building Lock 6A represented only a portion of expenditures on the part of the Pennsylvania to meet its lease obligations to maintain the canal and its associated structures, even as the railroad developed proposals for abandonment. As noted in 1930, "continual agitation by the State Highway Department, the City of Trenton and smaller communities" for the reconstruction of bridges over the canal "has resulted in large charges to Capital and Expenses and additional reconstruction is planned...and will have to be carried out, regardless of abandonment proceedings" (Pennsylvania Railroad 1930). This strongly suggests that the construction of Lock 6A and raising the aqueduct were undertaken with reluctance and only because of the importance the Pennsylvania Railroad placed on modernization of its main line by electrification.

REFERENCES CITED

[Note: The following repositories were searched in an unsuccessful attempt to locate original drawings of Lock 6A - New Jersey State Archives, New Jersey State Library, and the Trenton Public Library, Trenton, New Jersey; Engineering Society Library, New York, New York; Hagley Museum and Library, Wilmington, Delaware; Hugh Moore Historical Park and Museum, Easton, Pennsylvania; and the Pennsylvania Railroad, Philadelphia, Pennsylvania.]

Bastoni, Gerald

1982 Episodes from the Life of Canvass White, Pioneer American Civil Engineer. Proceedings of the Canal History and Technology Symposium 1: 50-95.

- Cawley, James and Margaret Cawley
1970 Along the Delaware and Raritan Canal. Fairleigh Dickinson University Press, Cranbury, New Jersey.
- Federal Highway Administration and New Jersey Department of Transportation
1983 The Delaware and Raritan Canal, 23Mel08, Site Analysis, Assessment of Condition and Proposed Mitigation Plan. Prepared by Louis Berger & Associates, Inc.
- Gordon, Thomas F.
1834 Gazetteer of the State of New Jersey. Daniel Fenton, Trenton.
- Heritage Conservation and Recreation Service
1981 Lehigh Canal: An HCRS Project Report. HCRS Publication Number 36.
- Madeira, Crawford C.
1941 The Delaware and Raritan Canal: A History. The Easterwood Press, East Orange, New Jersey.
- McKelvey, William J.
1975 The Delaware and Raritan Canal: A Pictorial History. Canal Press, York, Pennsylvania.
- Menzies, Elizabeth G.C.
1976 Passage Between Rivers. Rutgers University Press, New Brunswick, New Jersey.
- Pennsylvania Railroad
1930 Delaware and Raritan Canal. Appendix to Report on Proposed Abandonment. CONRAIL Records Data Base, RC #830, Package #13738, curated at New Jersey State Archives, Trenton.
- Sweet, E.
1880 The Engineering Problems Involved in the Proposed Improvement of the Erie Canal by Increasing the Depth of the Channel One Foot. Transactions of the American Society of Civil Engineers IX: 99-110.
- Veit, Richard F.
1963 The Old Canals of New Jersey. New Jersey Geographical Press, Little Falls.

Welch, Ashbel

1880 Ship Canal Locks Calculated for Operation by Steam.
Transactions of the American Society of Civil Engineers
IX: 293-314.